

Claims

1. A method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel Particulate Filter of a Diesel engine equipped with a turbocharger, said method comprising:

determining a need to reduce sulfur accumulations stored in said lean NO_x trap;

determining a desired rich combustion mode for temporary operation of the engine;

sensing the substrate temperature of said lean NO_x trap;

sensing the temperature of exhaust gas prior to the exhaust gas passing through a turbine stage of said turbocharger;

and

alternatingly operating said engine in a lean combustion mode and said desired rich combustion mode for respective predefined periods of time, said respective periods of time being of a frequency and duration sufficient to increase said substrate temperature of the lean NO_x trap to a temperature at which said sulfur accumulations stored in the lean NO_x trap are reduced and said Diesel particulate trap is simultaneously regenerated.

2. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 1, wherein said method includes controlling the air/fuel ratio and the frequency and duration of time of operation in said alternating lean and rich operating modes to prevent the temperature of the exhaust gas prior to passing through the turbine stage from exceeding a predefined value.

3. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 2, wherein said predefined value of temperature of the exhaust gas passing through the turbine stage is the maximum working temperature of the turbocharger.

4. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 1, wherein said determining a desired rich combustion mode for temporary operation of the engine includes determining that said engine is operating in a predefined low load region of the engine operating range, and said alternatingly operating said engine in a lean combustion mode and said desired rich combustion mode includes alternatingly operating said engine respectively in a lean low temperature combustion mode and a rich low temperature combustion mode.

5. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 1, wherein said determining a desired rich combustion mode for temporary operation of the engine includes determining that said engine is operating in one of a predefined medium and high load region of the engine

operating range, and said alternately operating said engine in a lean combustion mode and said desired rich combustion mode includes alternately operating said engine respectively in one of a standard Diesel combustion mode and a lean pre-mixed charge compression ignition combustion mode when lean combustion mode is desired, and in a rich pre-mixed charge compression ignition combustion mode when rich combustion is desired.

6. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 5, wherein the frequency and duration of said respective periods of time and the air/fuel ratio during the respective periods of time is modified in response to the sensed value of the substrate temperature of said lean NO_x trap.

7. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 1, wherein said determining a desired rich combustion mode for temporary operation of the engine includes determining that said engine is operating in one of a predefined medium and high load region of the engine operating range, and said alternately operating said engine in a lean combustion mode and said desired rich combustion mode includes alternately operating said engine respectively in one of a standard Diesel combustion mode and a lean pre-mixed charge compression ignition combustion mode when lean combustion is desired, and in one of a standard Diesel combustion mode and a pre-mixed charge compression ignition combustion mode, either of which may be supplemented by the post injection of fuel when rich combustion is desired.

8. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 1, wherein said method includes providing said sensed substrate temperature of the lean NO_x trap to a programmable electronic engine control unit and adjusting at least one engine operating parameter in response to the sensed substrate temperature.

9. The method for simultaneous removal of sulfur from a lean NO_x trap and regeneration of a Diesel particulate filter, as set forth in Claim 1, wherein said method includes controlling the mean air/fuel ratio to control the temperature and the temperature across said lean NO_x trap and said Diesel particulate filter.